ilr

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/823,305	04/13/2004	Scott Dewey	GP-303515	4775

7590 11/08/2006

CARY W. BROOKS
General Motors Corporation
Legal Staff, Mail Code 482-C23-B21
P.O. Box 300
Detroit, MI 48265-3000

EXAMINER	
MURALIDAR, RICHARD V	
ART UNIT	**PAPER NUMBER**
2838	

DATE MAILED: 11/08/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/823,305	DEWEY, SCOTT	
	Examiner	Art Unit	
	Richard V. Muralidar	2838	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 21 August 2006.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-20 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-20 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 13 April 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-20 are rejected under 35 U.S.C. 103(a) as being obvious over Barbetta [U.S. 6762587] in view of Yoshino et al. [U.S. 4937521].

With respect to Claim 1, Barbetta teaches a monitoring system [Fig. 1, 2, 3 fuel cell monitoring system] for monitoring the voltage potential of fuel cells in a fuel cell stack [Figs. 1, 2, 3 fuel cell stack 10, 20; col. 1 lines 12-20; col. 2 lines 36-43; col. 4 lines 6-12]; a conductor [Fig. 1, conductor 12; col. 4 lines 25-29; col. 5 lines 36-47; Fig. 2; conductive trace 21] positioned proximate to a voltage measuring means [Fig. 1, meter 13; col. 4 lines 30-35; col. 5 lines 52-63 the meter comprises attenuator 4 and amplifier 5]; a plurality of switches [Fig. 8, multiplexer 2; col. 6 lines 37-41] electrically coupled to the fuel cells and to the conductor [Fig. 7; col. 5 lines 52-63], said switches being selectively switched on and off to separately and selectively couple each fuel cell in the fuel cell stack to the conductor and generate a current flow therethrough [col. 7 lines 22-32]. Barbetta teaches a differencing amplifier 5 connected to an attenuator 4 (i.e. a voltage divider, col. 6 lines 14-17) as shown in Fig. 7 and disclosed in col. 5 lines 52-64, which is connected directly to the multiplexer 2 for reading the voltages of individual cells; said differencing amplifier providing an output signal indicative of the

voltage potential of the selected fuel cell [col. 5 lines 52-63]. Barbetta does not teach an intermediate stage between the fuel stack multiplexer (plurality of switches) and the differencing amplifier, comprising a Wheatstone bridge with a GMR resistor and two output ports.

Yoshino teaches a current sensor [col. 1 lines 8-12] comprising a Wheatstone bridge [Fig. 11; col. 8 lines 32-38], said Wheatstone bridge including at least one giant magnetoresistive (GMR) resistor [Fig. 11, magnetoresistor 1; col. 5 lines 7-13] and two output ports [Fig. 11, nodes 8a and B prime]; that includes sensing a magnetic field generated by the current flow through the conductor reduces the resistance of the GMR resistor and unbalances the Wheatstone bridge [col. 5 lines 37-41 and lines 52-55; col. 7 lines 4-5]; and a differencing amplifier [Fig. 11, comparator 40; col. 8 lines 38-41] electrically coupled to the output ports of the Wheatstone bridge.

Barbetta and Yoshino are analogous current measuring devices. At the time of the invention it would have been obvious to add a Wheatstone bridge with GMR type resistors to Barbetta for the benefit of accurately reading current/voltage of each cell whilst ensuring isolation existed between the cell's high voltage and the measurement electronics, particularly since Barbetta's sensor is connected to a conductive trace [Barbetta- col. 5 lines 36-43], and Yoshino's sensor is designed to sense current flowing through a conductive trace, without touching it [Yoshino- Fig. 11; col. 3 lines 49-63]. Additionally, Wheatstone bridges with GMR type resistors used to measure current from magnetic fields are widely known in the art, and would function *exactly the same way* whether connected to a single battery, multiple batteries, or multiple fuel-cells.

With respect to Claim 2, Barbetta teaches the switches are FET switches [col. 7 lines 37-41].

With respect to Claim 3, Yoshino teaches the at least one GMR resistor is two GMR resistors [Fig. 13, GMR resistors 1].

With respect to Claim 4, Yoshino teaches the conductor is an electrical trace positioned beneath the Wheatstone bridge [col. 1 lines 8-12; col. 3 lines 49-64; col. 5 lines 7-13].

With respect to Claim 5, Barbetta teaches a polarity reverser, said polarity reverser reversing the polarity of the current from the fuel cells before the current is applied to the conductor so that the current through the conductor is always in the same direction [the switch network shown in Fig. 13. connected to the individual fuel cells 1, in conjunction with the switch controller, is capable of doing this. A reason for the controller to reroute the switches to maintain the current flow in one direction would be to maintain the normal operating requirements of the monitor, which includes amplifier 5 and A/D converter 6 both of which are polarity dependent electronic devices. A polarity reversal through the sensing means would result in a failed input to microprocessor 7- Fig. 7, as well as possible damage to polarity dependent electronics].

With respect to Claim 6, Barbetta teaches least one voltage divider [Fig. 7, attenuator 4 is a voltage divider- col. 6 lines 14-17] electrically coupled between the fuel cells and the conductor.

With respect to Claim 7, Barbetta teaches a controller [Fig. 7., microprocessor 7; col. 5 lines 52-66] for controlling the switches to separately measure the voltage potential of each fuel cell and for receiving the output signal from the amplifier [Fig. 7, amplifier 5].

With respect to Claim 8, Barbetta teaches a plurality of opto-isolators for isolating the high voltage of the fuel cell stack and the switches from the low voltage of the controller [col. 7 lines 22-32 and lines 37-41, isolation may be provided, such as with mechanical relays; col. 6 lines 34-36, opto-isolators may also be used to provide isolation].

With respect to Claim 9, Barbetta teaches the system monitors the fuel cell stack on a vehicle [col. 3 lines 12-17].

With respect to Claim 10, Barbetta teaches a monitoring system [Fig. 1, 2, 3 fuel cell monitoring system] for monitoring the voltage potential of fuel cells in a fuel cell stack [Figs. 1, 2, 3 fuel cell stack 10, 20; col. 1 lines 12-20; col. 2 lines 36-43; col. 4 lines 6-12]; *an electrical trace* [Fig. 1, conductor 12; col. 4 lines 25-29; col. 5 lines 36-47; Fig. 2; conductive trace 21] positioned proximate to a voltage measuring means [Fig. 1, meter 13; col. 4 lines 30-35; col. 5 lines 52-63 the meter comprises attenuator 4 and amplifier 5]; a plurality of *FET switches* [Fig. 8, multiplexer 2; co. 6 lines 37-41, MOSFET switches] electrically coupled to the fuel cells and to the conductor [Fig. 7; col. 5 lines 52-63], said switches being selectively switched on and off to separately and selectively couple each fuel cell in the fuel cell stack to the conductor and generate a current flow therethrough [col. 7 lines 22-32]; and *a controller* [Fig. 7, microprocessor

7; col. 5 lines 52-63] for controlling the switching of the FET switches to separately measure the voltage potential of each fuel cell and for receiving the output signal from the amplifier. Barbetta teaches a differencing amplifier 5 connected to an attenuator 4 (i.e. a voltage divider, col. 6 lines 14-17) as shown in Fig. 7 and disclosed in col. 5 lines 52-64, which is connected directly to the multiplexer 2 for reading the voltages of individual cells; said differencing amplifier providing an output signal indicative of the voltage potential of the selected fuel cell [col. 5 lines 52-63]. Barbetta does not teach an intermediate stage between the fuel stack multiplexer (plurality of switches) comprising a Wheatstone bridge with a GMR resistor and two output ports.

Yoshino teaches a current sensor [col. 1 lines 8-12] comprising a Wheatstone bridge [Fig. 11; col. 8 lines 32-38], said Wheatstone bridge including at least one giant magnetoresistive (GMR) resistor [Fig. 11, magnetoresistor 1; col. 5 lines 7-13] and two output ports [Fig. 11, nodes 8a and B prime]; that includes sensing a magnetic field generated by the current flow through the conductor reduces the resistance of the GMR resistor and unbalances the Wheatstone bridge [col. 5 lines 37-41 and lines 52-55; col. 7 lines 4-5]; and a differencing amplifier [Fig. 11, comparator 40; col. 8 lines 38-41] electrically coupled to the output ports of the Wheatstone bridge.

Barbetta and Yoshino are analogous current measuring devices. At the time of the invention it would have been obvious to add a Wheatstone bridge with GMR type resistors to Barbetta for the benefit of accurately reading current/voltage of each cell whilst ensuring isolation existed between the cell's high voltage and the measurement electronics, particularly since Barbetta's sensor is connected to a conductive trace

[Barbetta- col. 5 lines 36-43], and Yoshino's sensor is designed to sense current flowing through a conductive trace, without touching it [Yoshino- Fig. 11; col. 3 lines 49-63]. Additionally, Wheatstone bridges with GMR type resistors used to measure current from magnetic fields are widely known in the art, and would function *exactly the same way* whether connected to a single battery, multiple batteries, or multiple fuel-cells.

With respect to Claim 11, Barbetta teaches a polarity reverser, said polarity reverser reversing the polarity of the current from the fuel cells before the current is applied to the trace so that the current through the trace is always in the same direction [the switch network shown in Fig. 13. connected to the individual fuel cells 1, in conjunction with the switch controller, is capable of doing this. A reason for the controller to reroute the switches to maintain the current flow in one direction would be to maintain the normal operating requirements of the monitor, which includes amplifier 5 and A/D converter 6 both of which are polarity dependent electronic devices. A polarity reversal through the sensing means would result in a failed input to microprocessor 7- Fig. 7, as well as possible damage to polarity dependent electronics].

With respect to Claim 12, Barbetta teaches at least one voltage divider [Fig. 7, attenuator 4 is a voltage divider- col. 6 lines 14-17] electrically coupled between the fuel cells and the trace.

With respect to Claim 13, Barbetta teaches a plurality of opto-isolators for isolating the high voltage of the fuel cell stack and the FET switches from the low voltage of the controller [col. 7 lines 22-32 and lines 37-41, isolation may be provided,

such as with mechanical relays; col. 6 lines 34-36, opto-isolators may also be used to provide isolation]

With respect to Claim 14, Barbetta teaches a method [Abstract, lines 1-3] for monitoring [Fig. 1, 2, 3 fuel cell monitoring system] the voltage potential of fuel cells in a fuel cell stack [Figs. 1, 2, 3 fuel cell stack 10, 20; col. 1 lines 12-20; col. 2 lines 36-43; col. 4 lines 6-12]; providing a conductor [Fig. 1, conductor 12; col. 4 lines 25-29; col. 5 lines 36-47; Fig. 2; conductive trace 21] positioned proximate to a voltage measuring means [Fig. 1, meter 13; col. 4 lines 30-35; col. 5 lines 52-63 the meter comprises attenuator 4 and amplifier 5]; selectively and separately electrically coupling the fuel cells to the conductor to generate a current flow through the conductor [Fig. 7; col. 5 lines 52-63; col. 7 lines 22-32]; and a differencing amplifier [Fig. 7, amplifier 5] providing an output signal indicative of the voltage potential of the selected fuel cell [col. 5 lines 52-63]. Barbetta does not teach an intermediate stage between the fuel stack multiplexer (plurality of switches) and the differencing amplifier, comprising a Wheatstone bridge with a GMR resistor and two output ports.

With respect to Claim 15, Barbetta teaches the method according to claim 14 wherein selectively and separately electrically coupling the fuel cells to the conductor includes using FET switches [Fig. 8, multiplexer 2; co. 6 lines 37-41, MOSFET switches] to selectively and separately electrically couple the fuel cells to the conductor [col. 7 lines 22-32].

With respect to Claim 16, Yoshino teaches providing a conductor positioned proximate to the Wheatstone bridge includes providing an electrical trace positioned beneath the Wheatstone bridge [col. 1 lines 8-12; col. 3 lines 49-64; col. 5 lines 7-13].

With respect to Claim 17, Yoshino teaches providing a Wheatstone bridge includes providing a Wheatstone bridge including two GMR resistors [Fig. 13, GMR resistors 1].

With respect to Claim 18, Barbetta teaches providing a polarity reverser for reversing the polarity of the current from the fuel cells before the current is applied to the conductor so that the current through the conductor is always in the same direction [the switch network shown in Fig. 13. connected to the individual fuel cells 1, in conjunction with the switch controller, is capable of doing this. A reason for the controller to reroute the switches to maintain the current flow in one direction would be to maintain the normal operating requirements of the monitor, which includes amplifier 5 and A/D converter 6 both of which are polarity dependent electronic devices. A polarity reversal through the sensing means would result in a failed input to microprocessor 7- Fig. 7, as well as possible damage to polarity dependent electronics].

With respect to Claim 19, Barbetta teaches providing at least one voltage divider [Fig. 7, attenuator 4 is a voltage divider- col. 6 lines 14-17] electrically coupled between the fuel cells and the conductor.

With respect to Claim 20, Barbetta teaches the fuel cell stack is on a vehicle [col. 3 lines 12-17].

Response to Arguments

Applicant's arguments filed 8/21/2006 have been carefully considered but they are not persuasive.

Applicant acknowledges that the combination of Barbetta [U.S. 6762587] and Yoshino [U.S. 4937521] produces an invention that measures the voltage of fuel cells using a GMR type sensor –per applicant's **RESPONSE TO OFFICE ACTION** pages 1 and 2. Applicant comments on pages 2 and 5 that what is not taught or suggested in the prior art is employing a GMR for sensing the voltage of fuel cells, i.e. although the combination produces the claimed invention, there is no motivation to combine the teachings of Barbetta and Yoshino. Applicant adds that improper hindsight has been used.

As noted by the applicant on page 3:- *MPEP 2143.01 I also states that "obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so, either explicitly or implicitly in the reference themselves, or in the knowledge generally available to one of ordinary skill in the art."*

The examiner has relied on the last portion of this statement "*...or in the knowledge generally available to one of ordinary skill in the art*" to meet the initial burden of proof in establishing the motivation to combine the Yoshino's GMR sensor with Barbetta's fuel cell stack. As noted in the action above, Wheatstone bridges with GMR type resistors used to measure current from magnetic fields are widely known in

the art, and would function *exactly the same way* whether connected to a single battery, multiple batteries, or multiple fuel-cells. The examiner also notes the following:

(1) Fuel cells are known to produce high voltages, either singularly or when combined into a stack as shown in Barbetta [Fig. 1, stack 10]. A stack can even be used as a power generation platform- [col. 1 lines 39-42]. This suggests to the examiner that a means of monitoring the quality of power produced i.e. the voltage; is necessary, since it is well known that loads require a stable source of power. This answers the question of why combine a fuel cell with a voltage/power monitor- the reason is to ensure quality power output to prevent damage to the load.

(2) The modern means of interpreting the monitored voltage/power [whether from a fuel cell, battery, or other means] is typically microprocessor or computer based- [col. 5 lines 63-66].

(3) It is well known that microprocessors/computers are low voltage based circuitry, which require isolation from the power supply for safety to equipment and users.

(4) This begs the question of the skilled artisan, how best to monitor the fuel cell voltage whilst ensuring isolation between the sensor/processor and the fuel cells?

(5) At this point the skilled artisan would look to the most common means of sensing, such as current sensing resistors, and toroid/current transformers, for example.

(6) The examiner believes that the skilled artisan would rule out current sensing resistors, because they offer no isolation and waste power through heat dissipation. Current transformers are explicitly ruled out in [col. 1 lines 14-40] because they are inaccurate and expensive, among other reasons.

(7) Based on 1-6, the examiner believes that the skilled artisan, faced with the references by Barbetta and Yoshino and the question outlined in (4), would look to the GMR as a means of sensing the voltage of the fuel cells as a means of accurately measuring the voltage of the fuel cells- [Yoshino, col. 5 lines 28-33]. With respect to the issue of isolation, [col. 5 lines 36-63] outlines the theory of operation of the GMR, which makes it clear that magnetic isolation is provided for between the fuel cell output conductor and the active sensing material of the GMR. This answers the question of why specifically use a GMR as the voltage monitoring means to sense voltage and provide isolation from the power supply- the answer is to provide increased sensor accuracy and power supply isolation.

(8) Additionally, it is noted that Yoshino teaches integrating the GMR sensor into a semiconductor integrated circuit- [col. 1 lines 54-56]; whilst Barbetta's fuel cell stack outputs power through conductors that can be on flexible circuit boards- [col. 4 lines 24-30] or conductive traces- [col. 5 lines 44-47]. This serves as an additional motivation/suggestion to combine Barbetta's fuel cell output with Yoshino's GMR monitoring means.

Points (1)-(8) establishes the motivation/suggestion as to why the skilled artisan would logically combine Barbetta and Yoshino to arrive at the applicant's claimed invention.

Applicant comments on page 5 that Barbetta does not teach a polarity reverser to keep the current through the conductor traveling in the same direction, and that Yoshino would not require a polarity reverser. The examiner's response is as follows:

The switch network shown in Fig. 13 connected to the individual fuel cells 1, in conjunction with the switch controller, is capable of doing this. A reason for the controller to reroute the switches to maintain the current flow in one direction would be to maintain the normal operating requirements of the monitor, which includes amplifier 5 and A/D converter 6 both of which are polarity dependent.electronic devices. A polarity reversal through the sensing means would result in a failed input to microprocessor 7- Fig. 7, as well as possible damage to polarity dependent electronics.

The examiner also notes that Yoshino does require a polarity reverser feature when implemented. Figs. 11 and 12 show that the GMR bridge sensor is connected to a comparator 40, or 41 and 42, to amplify the sensed magnetic field of current carrying conductor 3. If the current through conductor 3 were reversed, the input to comparators 40 or 41 and 42 would also be reversed. Since comparators are polarity dependent as shown in Fig. 12, the output terminal of Figs. 11 and 12 would fail to produce a useable signal.

This action is a **final rejection** and is intended to close the prosecution of this application. Applicant's reply under 37 CFR 1.113 to this action is limited either to an appeal to the Board of Patent Appeals and Interferences or to an amendment complying with the requirements set forth below.

If applicant should desire to appeal any rejection made by the examiner, a Notice of Appeal must be filed within the period for reply identifying the rejected claim or claims appealed. The Notice of Appeal must be accompanied by the required appeal fee. If

applicant should desire to file an amendment, entry of a proposed amendment after final rejection cannot be made as a matter of right unless it merely cancels claims or complies with a formal requirement made earlier. Amendments touching the merits of the application which otherwise might not be proper may be admitted upon a showing a good and sufficient reasons why they are necessary and why they were not presented earlier.

A reply under 37 CFR 1.113 to a final rejection must include the appeal from, or cancellation of, each rejected claim. The filing of an amendment after final rejection, whether or not it is entered, does not stop the running of the statutory period for reply to the final rejection unless the examiner holds the claims to be in condition for allowance. Accordingly, if a Notice of Appeal has not been filed properly within the period for reply, or any extension of this period obtained under either 37 CFR 1.136(a) or (b), the application will become abandoned.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Richard V. Muralidar whose telephone number is 571-272-8933. The examiner can normally be reached on 9:00-5:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Karl D. Easthom can be reached on 571-272-1989. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

11/1/2006
RVM

KARL EASTHOM
SUPERVISORY PATENT EXAMINER